Original Research Paper

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BACTERIOLOGICAL PROFILE OF NOSOCOMIAL ISOLATES FROM PATIENTS ADMITTED IN MEDICAL INTENSIVE CARE UNIT & THEIR ANTIBIOGRAM IN A TERTIARY CARE HOSPITAL IN NORTHERN KERALA.

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ABSTRACT

Introduction: Hospital acquired infections are one of the important causes which determine the mortality rate of patient admitted in ICUs. Identification of bacteria based on culture report and appropriate antimicrobial treatment are the essential factor for controlling the infections and thereby improving the quality of life. **Aim:** To determine the types, frequency of nosocomial bacterial isolates and their antibiotics susceptibility pattern. **Results:** A total of 82 organisms were isolated from 265 various clinical samples. Urinary tract infection 20(41.7%) was the most common infection in Medical Intensive care unit. The number of Gram positive isolates was 6 (12.5%) .42 (87.5%) Gram negative organisms were isolated. Among the Gram-negative isolates, Acinetobacter species 14(29.1%) and Klebsiella pneumoniae 14(29.1%) was the most frequently isolated organism. Among Gram negative bacilli minimum resistance was seen against Colistin and the most effective antibiotics against gram positive organisms, are Vancomycin(100%), Linezolid(100%) and Teicoplanin(100%). **Conclusions:** AMR surveillance allows healthcare centers to create **local antibiograms** specific to their region. Aggregating local surveillance data contributes to **national-level insights**. AMR **guides** clinicians in selecting **appropriate empirical therapy** for patients. Additionally, it assists in **escalating** or **de-escalating** antibiotic regimens based on susceptibility patterns. By regulating antimicrobial use, we can **preserve** the effectiveness of existing antibiotics and combat resistance. In summary, these studies are essential for informed decision-making, patient care, and safeguarding our precious arsenal of antibiotics.

KEYWORDS : Intensive care units (ICU), Multidrug Resistant Organisms (MDROs), Nosocomial infections

INTRODUCTION:

Antibiotics have played a crucial role in modern medicine[1]. Bacterial infections frequently lead to hospitalization, with **nosocomial infections** being particularly common in critical care settings[2]. These nosocomial infections occur in various forms, including respiratory tract infections, bloodstream infections, urinary tract infections, and soft tissue infections within **intensive care units (ICUs)**[3].

Antibiotic resistance is a global public health concern and a threat to humanity[4]. In India, the burden of infectious diseases is among the highest worldwide, and recent reports highlight the inappropriate and irrational use of antimicrobial agents, contributing to the rise of **antimicrobial resistance (AMR)**[5].

ICUs, where 5% to 10% of hospitalized patients receive treatment, account for approximately 25% of all nosocomial infections. Given that ICU patients often receive broad-spectrum antimicrobials, selective antibiotic pressure drives the development of antimicrobial resistance among ICU microorganisms[6]. Unfortunately, even effective drugs like fluoroquinolones, third-generation cephalosporins, and aminoglycosides are losing their efficacy against hospital pathogens, limiting antimicrobial choices for treating serious infections.

Early identification of bacteria and appropriate antimicrobial therapy are crucial for infection control, reducing morbidity, and improving quality of life. Therefore, our present study aims to determine the types and frequency of nosocomial bacterial isolates and their antibiotic susceptibility patterns.

MATERIALS & METHODS (Methodology):

We conducted a **cross-sectional study** over one year (from April 2023) at the Department of Microbiology, Malabar Medical College Hospital and Research Center in Kozhikode. After obtaining permission from the Institutional Ethics Committee (with letter no MMCH&RC/ IEC/ 2023/ 36), we included microbial isolates causing nosocomial infections from clinical samples of patients admitted to the medical ICU.

Sample Size:

$n = Z\square^2 pq/d^2$

$Z = 1.96$

$p = 22.8\%$ (Percentage of most frequently isolated organism)[3]

$q = 77.2\%$ (100 - p)

d = Relative precision

$= 4.56\%$ (20% of p)

$n = (1.96)^2 * 22.8 * 77.2/(4.56)^2$

$n = 325.$

Inclusion Criteria:

1. Samples collected after 48 hours of admission of the patient to medical ICU(MICU) are included.
2. The microbial isolates causing nosocomial infections like catheter associated urinary tract infections (CAUTI), catheter related blood stream infections (CRBSI), ventilator associated pneumonia (VAP) and hospital associated pneumonia (HAP) are included in the study.
3. Samples with single or mixed bacterial growth are included in the study.
4. Only samples containing pathogenic bacteria are selected for the study

Exclusion Criteria

1. Samples of other inpatients admitted in hospital are excluded from the study
2. Samples containing fungal isolates are not included in the study
3. Contaminated samples are excluded
4. Insignificant growth (less than 10^5CFU/ml) from the urine samples are excluded
5. Samples collected before 48 hours of admission of the patient to ICU are excluded.

Methods Including:

Method Of Data Collection:

Blood samples was collected under aseptic precautions in blood culture bottles. Urine specimens from catheterised patients was collected in universal containers. Respiratory samples like sputum and endotracheal aspirates were collected in sterile, wide mouth disposable containers. The containers were labelled with the name of patient, identification number, culture site, date of collection and time of collection. The specimens were transported to the laboratory within 30 minutes to 2 hours. The samples were inoculated on Blood agar and Mac Conkey's agar medium. The media was incubated at 37^0C for 24-48 hours. The isolates were identified and its antibiotic susceptibility pattern was performed by automated method (VITEK-2). Susceptibility pattern was interpreted by comparison of the MIC value according to the Clinical and Laboratory Standards Institute (CLSI, 2022) guideline and reported as sensitive, intermediate, and resistant.

Plan Of Analysis:

The data were entered into MS Excel, and statistical analysis was performed using SPSS 20.0. Numerical variables are presented as mean ± SD, while categorical variables are expressed as frequency and percentage. The association between results and outcomes will be assessed using the Chi-square test, with a significance level set at $p < 0.05$.

RESULTS:

During the study period, a total of **755 cases** were admitted to the medical ICU. Among these, **265 samples** were sent for culture and sensitivity testing. Out of the 265 samples (representing **35.1%** of the total), **82 cases** showed growth of organisms. Notably, **48 isolates**

(18.11%) were identified as **nosocomial isolates**.

Among the **82 isolates**, **51.2%** were male, and **48.8%** were female. The majority of cases were in the age group of **>60 years (80.4%)**, followed by the **40-60 years** age group (19.5%).

The most common sources of isolates were **urine samples (48.8%)**, followed by **blood samples (20.7%)**. These findings highlight the importance of monitoring nosocomial infections in the ICU setting.

Table 1 Distribution Of Clinical Samples From Medical ICU

Sample	Number	Percentage
Urine	40	48.8%
Blood	17	20.7%
Sputum	12	14.6%
Pus	7	8.5%
ET aspirate	6	7.3%
Total	82	100%

In the medical intensive care unit, **urinary tract infection (UTI)** was the most common infection, accounting for **41.7%** of cases. It was followed by **respiratory tract infections (RTI)** at **27%**, **bloodstream infections (BSI)** at **25%**, and **skin and soft tissue infections (SSTI)** at **6.3%**. The distribution of nosocomial isolates is depicted in Figure 1.

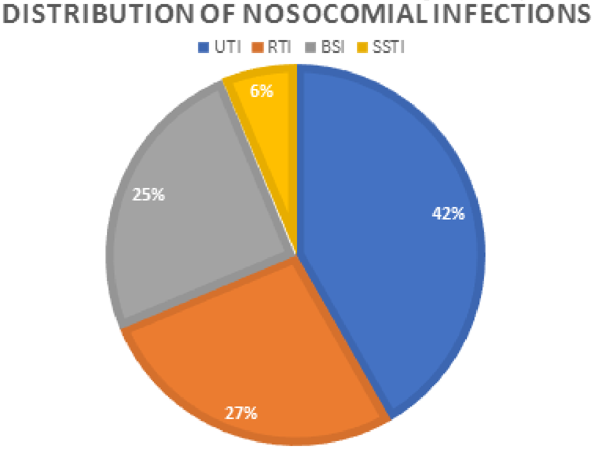

Fig 1. Distribution Of Nosocomial Isolates

The number of Gram positive isolates were 6 (12.5%)and 42 (87.5%) Gram negative isolates were obtained. Among the Gram negative isolates Acinetobacter species 14 (29.1%) and Klebsiella pneumoniae 14 (29.1%) were the most frequently isolated organisms followed by E. coli 11(23%), Pseudomonas aeruginosa 2 (4.2%) and Citrobacter species 1(2%). These findings emphasize the importance of understanding the susceptibility patterns of different bacterial isolates for effective treatment. The distribution of Gram negative organisms shown in table no.2.

Table No.2 Bacteriological Profile Gram Negative Organisms

Organisms	Number	Percentage
Acinetobacter species	14	29.1%
Klebsiella pneumoniae	14	29.1%
E.coli	11	23%
Pseudomonas aeruginosa	2	4.2%
Citrobacter species	1	2%

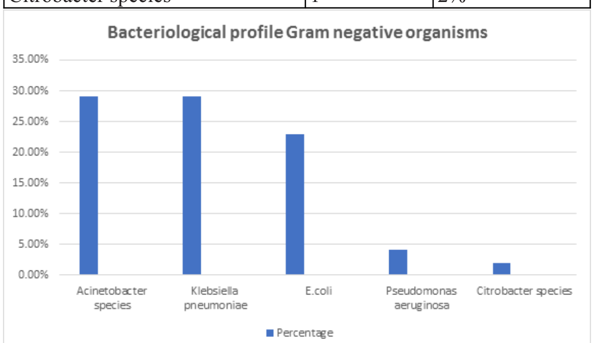

Fig 2: Bacteriological profile Gram negative organisms

The distribution of isolated organisms in different nosocomial infections:

1. Urinary Tract Infection (UTI):
- Caused by E. coli: 10 cases (20.8%)
- Major infection caused by Klebsiella pneumoniae: 7 cases (14.5%)

2. Respiratory Infections:
- Caused by Acinetobacter species: 8 cases (16.7%)

These findings highlight the significance of monitoring and managing nosocomial infections in different clinical contexts

Table No.3 Distribution Of Isolated Organisms In Different Nosocomial Infections

Organism	UTI	RTI	BSI	SSTI	Total
Acinteobacter species		8(16.7%)	5(10.4%)	1(2%)	14
Klebsiella pneumoniae	7(14.5%)	4(8.33%)	3(6.3%)		14
E.coli	10(20.8%)	1(2%)			11
Staph aureus			4(8.3%)	2(4.2%)	6
Pseudomonas aeruginosa	2(4.2%)				2
Citrobacter species	1 (2%)				1
Total organisms	20	13	12	3	48

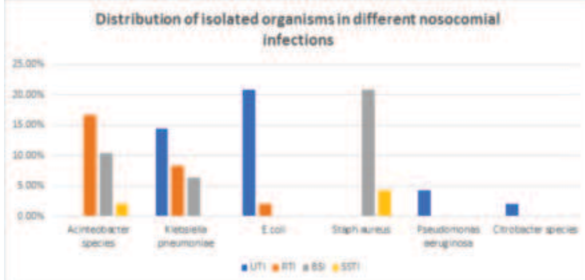

Fig 3: Distribution of isolated organisms in different nosocomial infections

Among the 48 nosocomial organisms isolated, all the Gram-negative organisms exhibited multidrug resistance. These isolates were resistant to three or more classes of antimicrobial agents, leaving Colistin as the only remaining effective antibiotic.

Specifically:
- Acinetobacter demonstrated the highest sensitivity to Cotrimoxazole (21.4%) and Amikacin (21.4%).
- Klebsiella pneumoniae was sensitive to Gentamicin (64.2%), followed by Ciprofloxacin (35.7%), Amikacin (21.4%), Cotrimoxazole (21.4%), and Cefaperazone sulbactem (21.4%).

These findings underscore the challenge of treating multidrug-resistant Gram-negative infections and highlight the importance of judicious antibiotic use.

Table No.4 Antibiotic Sensitivity Pattern Of Gram-negative Bacilli.

Antibiotic	Acinetobacter spp(14) %	E.coli (11) %	Klebsiella pneumoniae (14) %	Pseudomonas aeruginosa (2) %	Citrobacter species (1) %
Ampicillin		0			0
Ceftriaxone		0	0		0
Ceftazidime	0			0	
Cefepime	0	9.1	9.1	0	0
Amikacin	21.4	9.1	21.4	50	0
Gentamicin	0	0	64.2	50	0
Ciprofloxacin	0	9.1	35.7	0	0
Cotrimoxazole	21.4	9.1	21.4		0
Amoxicillin + Clavulanic Acid		18.2	9.1		0
Piperacillin+tazobactam	0	9.1	9.1	0	0

Cefoperazone + sulbactum	0	9.1	21.4	0	0
Imipenem	0	9.1	0	0	0
Meropenem	0	9.1	0	50	0
Colistin	0	0	0	0	0

The antibiotic sensitivity patterns for Staphylococcus aureus, including both MRSA (Methicillin-Resistant Staphylococcus aureus) and MSSA (Methicillin-Sensitive Staphylococcus aureus):
1. Vancomycin, Linezolid, and Teicoplanin:
Both MRSA and MSSA showed **100% sensitivity** to these antibiotics. They are effective choices for treating Staphylococcus aureus infections.

2. Gentamicin:
Among MRSA isolates, 66.7% were sensitive to Gentamicin.

3. Cotrimoxazole:
Also among MRSA isolates**, 66.7%** showed sensitivity to Cotrimoxazole.

4. Clindamycin:
Approximately 33.3% of MRSA isolates were sensitive to Clindamycin.

These findings provide valuable insights for selecting appropriate antibiotics in the management of Staphylococcus aureus infections

Table No.5 Antibiotic Sensitivity Pattern Of MRSA&MSSA

Antibiotic	**MRSA(3) %**	**MSSA(3) %**
Penicillin	0	100
Cefoxitin	0	100
Gentamicin	66.7	100
Ciprofloxacin	0	0
Erythromycin	0	66.7
Clindamycin	33.3	66.7
Cotrimoxazole	66.7	100
Vancomycin	100	100
Linezolid	100	100
Teicoplanin	100	100

DISCUSSION:

Intensive Care Units (ICUs) are crucial in healthcare, but they also present challenges due to Hospital Acquired Infections (HAIs) and the emergence of Multidrug Resistant Organisms (MDROs). These issues arise from factors like extended hospital stays, severe illnesses, and extensive antibiotic use. Among the causative agents of nosocomial infections, bacteria play a significant role[7].

To gain insights into this critical area, a study was conducted to analyze the bacteriological profile of nosocomial isolates from patients admitted to the medical ICU. Additionally, the study aimed to assess the antibiogram, which provides information about the susceptibility of these bacteria to various antibiotics.

In the study, **82 isolates** were examined, and **18.11%** of them were identified as nosocomial isolates. This finding was then compared with a study conducted by Moolchandani K et al[6].

The demographic analysis in this study revealed that nosocomial organisms were more frequently isolated from males compared to females, which aligns with findings from the study conducted by Moolchandani K et al[6]. However, there was an interesting contrast in the present study: the majority of isolates (**80.4%**) were obtained from the age group above 60 years. This diverged from the study by Qadeer A, Akhtar A et al[8], where they also observed a high proportion of isolates from the same age group. The potential explanation for this discrepancy could be related to impaired immunity in older individuals.

Here's a concise summary of the key findings from the study:

1. Sample Types:
- In the current study, the maximum samples received were urine (48.8%), followed by blood (20.7%).
- This observation was compared with a study conducted by Sharma DK et al[7].

2. Infection Patterns:
- While nosocomial infections in Intensive Care Units (ICUs) are typically respiratory tract infections, this study revealed a different trend.
- In the medical intensive care unit, the most common infection was urinary tract infection.
- Interestingly, this aligns with findings from the study conducted by Shalini S et al[9].

Bacterial Isolates:
- Among the total bacterial isolates, Gram-negative bacteria were more prevalent than Gram-positive bacteria.
- This trend was consistent with similar studies conducted by Qadeer A et al[8], Savanur SS et al[10], and Moolchandani K et al[6].

These patterns is crucial for healthcare professionals to tailor effective infection control strategies and optimize treatment approaches in medical ICUs.

Non-fermenting Gram-negative bacilli (NF-GNB) have become significant hospital-acquired pathogens due to the irrational use of antimicrobials. In the present study, Acinetobacter species, a type of non-fermenting Gram-negative organism, were the most commonly isolated pathogens. These findings align with a study conducted by Qadeer A et al[8].

Interestingly, in this study, respiratory infections were associated with Acinetobacter species, while urinary tract infections were linked to E. coli. These observations were consistent with the study conducted by Qadeer A et al[8]. Such insights are invaluable for tailoring targeted interventions and improving patient outcomes in medical ICUs.

Antimicrobial resistance remains a major clinical challenge in ICUs. Studies have reported both multidrug resistance and pandrug resistance[6]. In this study, the antimicrobial resistance pattern was analyzed across three categories:
1. Non-fermenting Gram-negative bacilli (NF-GNB)
2. Enterobacteriaceae Gram-negative bacilli (EB-GNB)
3. Gram-positive organisms

Understanding these resistance patterns is essential for informed antibiotic prescribing and effective management of infections in critically ill patients.

1. NF-GNB Resistance:
- The study revealed a high degree of resistance among non-fermenting Gram-negative bacilli (NF-GNB) to almost all tested classes of antimicrobials, including cephalosporins, carbapenems, aminoglycosides, and **quinolones**.
- These results were consistent with studies conducted by Moolchandani K et al[6] and Quadeer et al[8].

2. Acinetobacter Resistance:
Among Acinetobacter isolates, the highest resistance was observed against:
- Carbapenems (100% resistance)
- Cephalosporins (100% resistance)
- Quinolones (100% resistance)
- Piperacillin-tazobactam and Cefaperazone-sulbactam

The most effective drug in this study was **Colistin**, which was also consistent with findings from studies by Quadeer et al[8] and Rajan et al[6].

3. Pseudomonas Resistance:
- Pseudomonas isolates also exhibited resistance to almost all classes of antimicrobials tested.
- Specific resistance patterns included:
- 50% resistance to Meropenem and Aminoglycosides
- 100% resistance to third-generation Cephalosporins, piperacillin-tazobactam, and Cefoperazone-sulbactam.
- These findings aligned with studies conducted by Quadeer et al and Raakhee T et al.

4. Multidrug Resistance:
- Multidrug-resistant Pseudomonas and Acinetobacter species were frequently colonized in the respiratory tracts of ICU-admitted patients.
- Factors such as multiple antibiotics and comorbid conditions (e.g., endotracheal tube insertion, prolonged ventilation) contributed to this colonization.

EB-GNB Resistance:
Among Enterobacteriaceae Gram-negative bacilli (EB-GNB), the following resistance rates were noted:

Cephalosporins: Ranged from 9.1% to 100%

Quinolones: Ranged from 35.7% to 9.1%

Aminoglycosides: Ranged from 21.4% to 9.1%

Beta-lactamase inhibitors: Ranged from 21.4% to 9.1%

Significant resistance to carbapenems (ranging from 9.1% to 100%)

Citrobacter species exhibited higher resistance compared to E. coli.

Colistin emerged as an effective antibiotic against multi-drug resistant EB-GNB.

These findings were consistent with studies by Moolchandani K et al[6], Quadeer et al[8], and Mohammadi-mehr et al[11].

Gram-Positive Group Resistance:
Among Gram-positive organisms:
Vancomycin, Linezolid, and Teicoplanin demonstrated 100% sensitivity.

These results aligned with studies conducted by Moolchandani K et al[6] and Cepeda, J.A et al[13].

However, Staph aureus exhibited a higher degree of resistance to Ciprofloxacin (100%) in our study, whereas the study by Moolchandani K et al[6] reported 69% resistance.

This discrepancy may be attributed to increased usage of the antibiotic. These findings emphasize the need for judicious antibiotic prescribing practices and continuous surveillance of resistance patterns to combat multidrug-resistant pathogens.

CONCLUSION:
The number of Multi drug resistant organism in the ICU are increasing day by day. The main reasons that can be attributed to these rises in numbers are the overuse or misuse of antibiotics, Lack of Responsible Antimicrobial Stewardship, Inadequate Infection Control practices. Using empirical antibiotic agents based on the hospital antibiogram and tailoring antibiotic therapy according to culture and sensitivity reports is essential. This approach helps reduce the development of drug resistance and prevents indiscriminate antibiotic use.

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